

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Apparatus for Cleaning the Exhaust Gases of Internal Combustion Engines

5 We, SCHWEIZERISCHE LOKOMOTIV- UND MASCHINENFABRIK, a Body Corporate organised and existing under the Laws of Switzerland, of Winterthur, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 As is known, Diesel engines tend to have a smoky exhaust when they are started from cold or are subjected to overloading. Furthermore, the exhaust gases, particularly under these operating conditions, sometimes have such an unbearably irritating smell and such a high content of carbon monoxide (CO) that they can be dangerous to health.

15 In order to obviate such disadvantages, attempts have been made, in the case of motor-driven vehicles which operate in mines, stores and similar places, to construct the exhaust pipe as an ejector arrangement with admixture of fresh air and to guide the mixture subsequently through a filter device. But such apparatus have the disadvantage that they operate correctly only when the engine is hot, whilst during starting and during idling smoke and gases dangerous to health can again be formed. Furthermore, the filter device rapidly becomes fouled by the partly moist and partly very hot exhaust gases.

20 With other known apparatus, a water bath with a following cyclone separator are used for cleaning the exhaust gases, but such apparatus owing to their wet operation have a really marked tendency to become fouled, with reduced efficiency.

25 The object of the present invention is to obviate disadvantages of this nature, i.e. to make the exhaust gases harmless under all operating conditions of the engine. It relates to an apparatus for cleaning the exhaust gases of internal combustion engines in which the exhaust gases are mixed with fresh air by an ejector arrangement and then guided through

a separator acting to clean the gases. According to the invention, this problem is solved in that there is arranged in the fresh air supply duct, a throttle valve the position of which is so influenced by a thermostat situated in the exhaust gas piping upstream of the separator that the temperature of the exhaust gas/air mixture at the thermostat measuring point does not fall below a predetermined lower limit and does not exceed a predetermined upper limit.

50 The arrangement according to the invention is particularly advantageous if the separator used is an electrostatic filter working on the Bacquerel principle. In this well-known type of filter, which will be referred to for brevity as an "electro-filter", the solid particles present in the gas stream, after being given a positive charge, are caused to adhere together in a negatively charged condenser so that they separate out of the gas stream. On the one hand such filters absorb very fine impurities, while on the other hand they no longer operate correctly if they are fouled or if the insulating property of the gases flowing through them varies substantially. Therefore, the dew point is chosen as the lower temperature limit.

55 One embodiment of the invention is illustrated by way of example in the accompanying drawings, in which Figs. 1 and 2 are a diagrammatic cross-section and a side view respectively of an internal combustion diesel engine equipped with the apparatus according to the present invention. In Fig. 1, certain parts of the apparatus are shown turned through 90° for clarity of illustration.

60 The internal combustion engine comprises four cylinders 1, each with a piston 2, admission and exhaust valves 3, 4, and an exhaust duct 5. The air charge enters the engine through a duct 6. Each exhaust duct 5 opens into an ejector nozzle 7 with a fresh air duct 8 and a downstream diffuser 9. Fresh air is supplied to the diffusers 9 from an inlet duct 10 in which a throttle valve 11 is arranged.

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The exhaust gases are discharged at the lower ends of the diffusers 9 into a manifold 12 and leave the engine through an electrofilter 13.

5 The installation operates as follows. The exhaust gases expelled through the ejector nozzles 7 suck in fresh air from the inlet duct 10, whereupon the mixture is again somewhat compressed in the diffusers 9. Since the position of the throttle valve 11 is controlled by a thermostat 14 arranged in the exhaust gas piping upstream of the electrofilter 13, the quantity of incoming air depends directly on the temperature prevailing upstream of the electrofilter 13. The inter-connection between the thermostat 14 and throttle valve 11 is indicated by a broken connecting line between them. At low temperatures, i.e. when starting, the valve 11 closes to a substantial extent, and it opens under increasing load as the temperature increases. The exhaust gases flowing through the diffusers 9 are subjected to a more or less intensive cooling action in accordance with this variable inflow of fresh air. The control conditions are so arranged that the temperature of the exhaust gas/air mixture in the electrofilter 13 is always above the dew point and on the other hand remains below an upper limit of about 200°C. Keeping within these temperature limits is important for satisfactory functioning of the electrofilter 13. For, if the exhaust gas temperature drops below the dew point, the plate grids of the electrofilter become fouled after a short working life. On the other hand, if the exhaust gas temperature rises considerably beyond the said upper limit, the electrical conductivity of the gas layers between the plates also increases. In the first case, the plates will collect an acid-containing coating which can give rise to corrosion. In the second case, electrical flashovers from plate to plate are promoted, which is also detrimental to the operation of the electrofilter. Owing to the addition of fresh air to the exhaust gases, their content of carbon monoxide which may have formed owing to incomplete combustion in the cylinders decreases to a lower percentage. Generally, a content of about 0.01% is regarded as not detrimental to health.

When the engine is idling, there will be a reduced temperature at the measuring point upstream of the electrofilter 13, so that in this operating condition the throttle valve 11 remains completely or almost completely closed under the influence of the thermostat 14 and then no fresh air is admixed. However, it is not necessary at this time to dilute the CO gases further, since the air surplus present in the exhaust gases is at this time in any case quite considerable. On the other hand, when the engine is overloaded, there is a relatively high temperature prevailing at the measuring point and therefore the thermostat 14 initiates an opening of the throttle valve 11. The fresh

air which then enters is all the more necessary since the proportion of CO in the gases and the exhaust gas temperature have now reached their maximum values. Therefore, the dilution of the CO gases and the cooling of the electrofilter 13 are carried out as desired. The electrofilter 13 is also capable of absorbing the smoke content, and hence also those constituents which have an unpleasant smell and irritate the olfactory organs, to a considerable extent under all operating conditions.

The arrangement also has an advantageous effect as regards the general operation of the engine, since the diffuser causes, by way of reaction, an intensification of the scavenging operation at the instant of simultaneous opening of the admission and exhaust valves and thus a further improvement in the quantity of excess air.

The engine is also provided with a deodorising device by means of which foul-smelling gases can be made odourless by the addition of chemical substances. A container 16 is provided in an elevated position for this purpose. It contains a smell-eliminating liquid which can pass through a cock 17 and an adjoining outflow pipe 18 into the mixing tube 9. Since there is a negative pressure at the narrowest region of the ejector 7, coincident with the lower end of the pipe 8, a corresponding suction effect is also exerted at the outlet of the pipe 18, which contributes to the effective atomisation of the deodorising substance as it enters the mixing tube 9. It is sufficient to arrange the deodorising device on a single cylinder since the atomised substance is also admixed with the exhaust gases discharged from the other cylinders into the manifold 12.

In addition to the automatic control of the throttle valve by a thermostat, it would also be possible to provide an independent and arbitrary control arrangement in parallel therewith. For example, the throttle valve 11 can be connected by a slotted rod to the fuel regulating lever. An additional arrangement of this kind makes it possible to close the throttle valve arbitrarily when the engine is idling, and thus to prevent reliably any admixture of fresh air with corresponding cooling of the exhaust gases. Since the engine in any case is operating with very considerable air excess under this low load and therefore produces only small CO percentages, the admixture of fresh air is not necessary then in any case.

WHAT WE CLAIM IS:—

1. Apparatus for cleaning the exhaust gases of internal combustion engines, in which the exhaust gases are mixed with fresh air by an ejector effect and then conducted through a separator acting to clean the gases, characterised in that there is arranged in a fresh air supply duct a throttle valve the position of which is so influenced by a thermostat situated in the exhaust gas piping upstream of the separator that the temperature of the exhaust

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gas/air mixture at the thermostat measuring point does not fall below a predetermined lower limit and does not exceed a predetermined upper limit.

- 5 2. Apparatus according to claim 1, wherein an electrostatic filter is used as the separator, characterised in that the lower temperature limit is equal to the dew point for the conditions at the measuring point.

- 10 3. Apparatus according to claim 1, characterised in that an outlet pipe of a deodorising

device is arranged to discharge into the fresh air supply duct of an ejector which is arranged to produce the said ejector effect.

4. Apparatus for cleaning the exhaust gases 15 of internal combustion engines, substantially as described with reference to the accompanying drawings.

REDDIE & GROSE,
Agents for the Applicants,
5, Bream's Buildings, London, E.C.4.

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